

**Tennessee.**—The mean temperature was 45.0°, or 2.2° below normal; the highest was 84°, at Chattanooga and Newport on the 29th, and the lowest, 14°, at Bristol on the 11th and 20th. The average precipitation was 6.33, or 1.25 above normal; the greatest monthly amount was 10.48, at McMinnville, and the least, 3.21, at Chattanooga.

**Texas.**—The mean temperature was 1.4° below normal; the highest was 105°, at Fort Ringgold on the 30th, and the lowest, 12°, at Happy on the 12th. The average precipitation was 0.43 below normal; there was a general deficiency, except over the east coast district, where the excess ranged from 0.42 to about 5.00, with the greatest in the vicinity of Houston. The greatest monthly amount, 8.58, occurred at Houston, while there was no rain at Camp Eagle Pass, Fort Ringgold, Fort Stockton, Menardville, Midland, and Sierra Blanca.

**Utah.**—The mean temperature was 38.0°; the highest was 88°, at Moab on the 25th, and the lowest, 7° below zero at Heber on the 5th, and at Soldier Summit on the 31st. The average precipitation was 0.99; the greatest monthly amount was 3.46, at Millville, and the least, "trace," at Cisco and Giles.

**Virginia.**—The mean temperature was 41.6°, which was somewhat below normal; the highest was 77°, at Bonair on the 30th, and the low-

est, 1° below zero, at Dale Enterprise on the 13th. The average precipitation was 4.44; in the Tidewater it was 1.47 below normal; in Middle Virginia, slightly above, and in the Great Valley, 2.09 above normal. The greatest monthly amount was 12.73, at Bigstone Gap, and the least, 1.38, at Cape Henry.

**Washington.**—The mean temperature was 40.1°, or 0.9° below normal; the highest was 77°, at Kennewick on the 18th, and the lowest, 8° below zero, at Colfax on the 4th. The average precipitation was 2.73, or 0.78 below normal; the greatest monthly amount was 9.96, at Cascade Tunnel, and the least, 0.11, at Moxee.

**West Virginia.**—The mean temperature was 35.7°, or about 5.0° below normal; the highest was 76°, at Beverly on the 28th, and the lowest, 10° below zero, at Bloomery on the 13th. The average precipitation was 4.45, or about 1.25 above normal; the greatest monthly amount was 8.40, at Elkhorn, and the least, 1.76, at Rowlesburg.

**Wisconsin.**—The mean temperature was 23.6°, or 5.9° below normal; the highest was 66°, at Prairie du Chien on the 30th, and the lowest, 21° below zero, at Hayward on the 13th. The average precipitation was 1.33, or 1.17 below normal; the greatest monthly amount was 3.40, at Spooner, and the least, 0.30, at Stevens Point.

## SPECIAL CONTRIBUTIONS.

### RECENT PUBLICATIONS ON METEOROLOGY.

By Dr. J. H. McCARTY, Librarian Weather Bureau.

In response to the requests from several correspondents, the Chief of the Weather Bureau has directed that there be published regularly in this REVIEW a list of recent publications bearing on meteorology and such other subjects as come within the field of study of the officials of the Weather Bureau. In this list of authors and titles the works that have been received by the Library of the Weather Bureau will take precedence, but other works whose titles are known will also be mentioned, although they have not yet been received, in order that the correspondents of the Weather Bureau may thus receive early notice of the publication of works in which they are interested. It is to be understood, however, that those who wish to consult the works on meteorology received by the Weather Bureau must do so in its own Library, where every convenience for study is afforded, as, in fact, is also the case in all the other scientific libraries in Washington.

**Belgium.**—Observatoire de Belgique. *Annuaire*, 1896. 553 pp. 32mo. Bruxelles. 1896.

**Blue Hill Meteorological Observatory.**—*Observations made in the year 1894. Under the direction of A. Lawrence Rotch. With an appendix containing anemometer comparisons.* (Extr.) Annals Harvard College Observatory. Cambridge. 1895. Vol. XL. 93 pp. 3 pl.

**Blue Hill Meteorological Observatory.**—S. P. Ferguson. *Anemometer comparisons at the Blue Hill Meteorological Observatory.* (Annals Astr. Obs'y, Harvard College. Vol. XL. Part IV. Pages 265-299. 3 pl. 4to. Cambridge. 1896.

**Canada.**—The Canadian Institute. *Transactions.* Vol. IV, No. 8. Pt. 2. 368 pp. 8vo. Toronto. 1895.

**Canada.**—David Boyle. *Archæological Report*, 1894-5. 8vo. Toronto. 1896.

**China.**—Zi-ka-wei. Observatoire Magnetique et Meteorologique. *Bulletin mensuel.* Annee 1894. *Troisième trimestre.* 4to. Pages 109-162. *Quatrième trimestre.* 4to. Pages 163-230. Chang-Hai. 1895.

**China.**—Hong Kong Observatory. *The China Coast.* Met. Register. Fol. Hong Kong. 1895.

**France.**—Commission Internationale des poids et mesures. *Process-verbaux.* 182 pp. 8vo. Paris. 1894.

**Hamburg.**—Deutsche Seewarte. Deutsches Meteorologisches Jahrbuch für 1893. *Ergebnisse der Meteorologischen Beobachtungen an 10 stationen II Ordnung und an 45 Signalstellen sowie stündliche Aufzeichnungen 2 Normal-Beobachtungsstationen.* Jahrgang XVI. Fol. Hamburg. 1894. Jahrgang XVII. Fol. Hamburg. 1895.

**Hamburg.**—Staats Medicinisch Statistik, 1893. 70 pp. 8 Taf. 1894. 98 pp. 11 Taf. Hamburg. 1895.

**Hamburg, H. E.**—*Översikt af Sveriges Klimat.* 12mo. Upsala. 1895. 82 pp.

**Habana.**—Real Colegio de Belen. B. Viñes, S. J. *Investigaciones en los huracanos de los Antillas.* 79 pp. Habana. 1895.

**Hettner, Alfred.**—Geographische Zeitschrift. Erster Jahrgang. 712 pp. 8vo. Leipzig. 1895.

**Indian Meteorological Memoirs.**—Vol. VII. *Meteorological observations recorded at the Trevandrum Observatory during the years 1853 to 1864, under the superintendence of the late J. Allen Braun.* Edited by J. Eliot, Meteorological Reporter. Part III. Vapor Tension. Fol. Simla. 1895.

**Lick Observatory.**—*Contributions from Lick Observatory No. 5. Meteors and sunsets observed by the astronomers of Lick Observatory in 1893, 1894, and 1895.* 8vo. Sacramento. 1895. 86 pp. 17 pl.

**London.**—Meteorological Office. *Daily Weather Reports, 1st January to 30th June, 1895.* 4to. London. 1895.

**London.**—Meteorological office. *Hourly means of the readings obtained from the self-recording instruments at the five observatories under the Meteorological Council, 1891.* Official No. 113. 4to. London. 1895. 140 (50) pp. 9 pl.

**London.**—Meteorological office. *Meteorological observations at stations of the second order for the year 1891.* (Appendix giving results for certain stations for the 15 years, 1876-1890.) Official No. 117. 4to. London. 1895. 195 pp. 1 map.

**London.**—British Association advancement of science, 1895. *Report of the sixty-fifth meeting at Ipswich, September, 1895.* 884 pp. With list of officers, members. Pages 1-118. 8vo. London. 1895.

**London.**—Royal Meteorological Society. *The meteorological record.* Monthly results of observations made at the stations of the society, with remarks on the weather for the quarter ending September 30, 1895. London. 1895.

**Means, James.**—Aeronautical Annual, 1895. 158 pp. 16 pls. Boston. 1896.

**Michigan.**—State Board of Health. *Twenty-first annual report.* 444 pp. 8vo. Lansing. 1895.

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**New South Wales.**—H. C. Russell. *Icebergs in the Southern Ocean.* (Paper read before the Royal Society of New South Wales). 31 pp. 1 pl., No. XII. 8vo. Sydney. 1895.

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**New South Wales.**—H. C. Russell. *The meteor of June 27, 1894.* 3 pp. 8vo. Sydney. 1895.

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**Norway.**—Norwegischen Meteorologische Institut, Jahrbuch, 1893. 109 pp. 4to. Christiania. 1895.

**Prussia.**—K. Preuss. Met. Institut. Bericht des Internationalen Meteorologischen Comites und der Internationalen Commission für Wolkenforschung. Versammlung zu Upsala, 1894. 8vo. Berlin. 1895. 45 pp.

**Saxony.**—K. Sachs. Met. Institut. *Wetterbericht des Königl. Sächsischen Meteorologischen Instituts in Chemnitz.* 267 pp. 8vo. Chemnitz. 1894.

**Saxony.**—K. Sachs. Met. Institut. *Das Klima des Königreiches Sachsen.* Heft III. 4to. Chemnitz. 1895. 65 pp.

**South Australia.**—Adelaide Observatory. *Meteorological observations made at the Adelaide Observatory and other places in South Australia and the northern territory during the year 1883*, 277 pp.; in 1888, in 3 sections, 136 pp.; 1893, 4 sections, 170 pp. Adelaide. 1896.

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**United States Hydrographic Office.**—*Sailing directions for the Gulf Coast of the United States, Caribbean Sea and Gulf of Mexico.* Supplement No. 2. 71 pp. 8vo. 1891.

**Wisconsin University.**—*Annual Report of the Agricultural Experiment Station.* Vol. XII. 349 pp. 8vo. Madison. 1895.

### THE TORNADO OF MAY 27 AT ST. LOUIS, MO.

By H. C. FRANKENFIELD, Local Forecast Official. (Seventy-fifth meridian time has been used throughout this report.)

The tornado which passed through St. Louis late in the afternoon of May 27 was the culmination of a protracted period of abnormally high temperatures, intensified during the latter portion of the time by unusually high humidity. From April 9 to May 27, both inclusive, a period of forty-nine consecutive days, the mean temperature at St. Louis varied from 2° to 21° above the normal. The mean temperature for the month of April was 8° above the normal, and 4° higher than any previous record in the history of the Weather Bureau station in St. Louis. The mean temperature for the month of May was 7° above the normal, and 1.5° higher than any previous record.

The relative humidity was almost exactly normal during April, while during May it was 74 per cent, or 8 per cent more than the normal amount. From May 14 to May 27 it was continuously high at 8 a. m., the average for the period of fourteen days being 88 per cent, or 14 per cent more than the normal amount for that time of the day.

Again, with the exception of three days, the barometric pressure throughout the West for the seven weeks previous to May 27 had been below the normal, with relatively higher pressure in the East and Southeast. Before one depression would disappear in the West another would be seen waiting to take its place. This constant succession of low areas caused the winds to blow persistently from a southerly direction, carrying with them heat and moisture. During April southerly winds prevailed at St. Louis during 69 per cent of the time, and during May during 78 per cent of the time. The bricks and stones in the buildings and streets thus became an enormous storehouse of heat, free radiation at night being prevented by smoke and dust.

At 8 a. m., May 27, the weather map showed the pressure to be low throughout the West, except in the extreme northwest, with the center of depression covering Kansas and Nebraska, the inner isobar being drawn for 29.70 inches. The State of Missouri was, therefore, in the southeast quadrant of the low area. Clear weather, with southerly winds, prevailed through Kansas, Oklahoma, Missouri, and Arkansas, with temperatures ranging from 66° to 78°. The relative humidities were abnormally high, particularly so in Missouri, that at St. Louis being 94 per cent. From Kansas and Nebraska eastward the isotherms of 60° and 70° crossed the isobars at right angles. The position of the State of Missouri in the southeast quadrant of the storm area, combined with the isothermal conditions above mentioned, the high humidity, and the high temperatures, indicated the occurrence of severe local storms within a short time. At St. Louis at 8 a. m. the pressure was 29.92 inches, the temperature 70°, and the relative humidity 94 per cent. The winds were blowing from the south, with a velocity of 8 miles per hour, and the sky was

about one-third covered with cumulo-stratus clouds, with some traces of cirro-stratus, both moving from the southwest. By noon the barometer had fallen .05 inch, to 29.87, and the temperature had risen to 80°. The winds remained mostly in the south, with a slightly increased velocity, reaching 12 miles at noon. The abnormally high humidity continued, and the sky became hidden by a uniform covering of alto-stratus clouds, through which the sun shone lazily, not enough to glare uncomfortably, but still sufficiently to cast a well-defined shadow.

From noon until 1.45 p. m. the barometer remained stationary and the winds shifted slightly to the southwest, averaging from 7 to 10 miles per hour. The temperature rose to 86°, and the veil of alto-stratus clouds still hung over the city. By 2 p. m. the barometer had commenced to fall rapidly, and the winds had changed to southeast, with slowly increasing velocity. The fall in pressure was intermittent, but at the same time persistent, and by 6 p. m. the reading was 29.59 inches, a fall of 0.28 inch since noon, and a fall of 0.09 inch during the twenty minutes immediately preceding. The winds continued from the southeast with gradually increasing velocity until 5.45 p. m., when they changed to east-northeast with a sudden increase in velocity, reaching 45 miles per hour from 5.55 to 6 p. m.

At 3.45 p. m. the temperature commenced to fall, and by 6 p. m. had fallen 9°, to 77°. The clouds slowly increased in density, and at 3.35 p. m. the sun was obscured. The character of the clouds changed about this time to cumulus, but of a very peculiar formation. The whole sky was compactly covered with small cumuli of almost perfect hemispherical shape, but with the rounded portions underneath.\* Their color was a dark gray with deep shadows on the sides farthest from the sun. By 4.30 p. m. these clouds had settled into a uniform covering of stratus, which commenced to assume a light green color in the extreme northwest, spreading more toward the west and north. Thunder and lightning commenced at 5.06 p. m., and rain in the form of large, scattered drops, at 5.43 p. m. At 6.04 p. m. there was a marked increase in the violence of the storm, although from 6 to 6.10 p. m. the winds changed again to southeast, with decreased velocity of from 33 to 36 miles per hour. During this period the barometer rose 0.08 inch, to 29.67, and fell almost instantly 0.10 inch, to 29.57. It again rose 0.10 inch in less than five minutes, to 29.67. During the next fifteen minutes (to 6.30 p. m.), it fell 0.31 inch, to 29.36, and then instantly rose 0.40 inch, to 29.76. It then continued in a series of sharp oscillations of from 0.05 to 0.10 inch, until 10 p. m., when the oscillations became smaller, ceasing finally at midnight, when a steady rise commenced.†

The winds at 6.10 p. m. once more changed suddenly, this time 180° to the northwest, and with greatly increased velocity, reaching 80 miles per hour from 6.15 to 6.20 p. m., with an extreme velocity of 120 miles per hour at 6.18 p. m. At

\* Mammato-cumulus. See in this connection the REVIEW of March, 1894. Mr. J. C. Widmeyer, observer, Weather Bureau, Oklahoma, Okla., has also noticed the same cloud formation on days when tornadoes formed in the Territory. No special significance seems to attach to the phenomena, except that of a gradual descent or sinking of the air.

† Note added by Mr. Frankenfield, June 23, 1896. "I have just learned of the height of the barometer, within a reasonable degree of accuracy, in or very near the center of the track of the tornado at the time it moved through Lafayette Park. It was in this park that the storm was at its height. An aneroid barometer, with a metrical scale, was brought to me to be reset, and I was informed that it was the property of the widow of the late Richard Klemm, ex-Park Commissioner of this city. The family live on Missouri Avenue, immediately fronting the park, and a son of Mr. Klemm read the barometer as the storm struck their place. He called the attention of his mother to the remarkably low reading, 680 mm., or 26.78 inches. Allowing for difference in elevation and reduction to sea level, this would indicate a reduced reading of 27.30 inches, or 2.05 inches lower than observed at this office."—ED.